CHAPTER 3: RESOURCE FUNCTIONS AND CONSIDERATIONS

INTRODUCTION

Section 373.0421 (1)(a), F.S., identifies the types of water resource functions that should be considered for protection from significant harm. A minimum flow and level (MFL) may be used to protect any one of a number of functions, such as navigation, recreation, fish and wildlife, or water quantity/quality. The present chapter briefly reviews the diverse water resource functions of Florida Bay and identifies water resource functions that should be considered in defining significant harm.

The previous chapter provided a general description of this system's natural features, hydrologic conditions, structural alterations and operational protocols. When setting a minimum flow or level, water management districts are required to consider changes and structural alterations that have occurred to a water resource. This chapter looks at the functions of the bay and the watershed.

WATER RESOURCE FUNCTIONS AND CONSIDERATIONS

Florida Bay

The primary resource function of Florida Bay is its highly productive estuarine habitat for a diverse faunal community. Another important function is recreation.

Freshwater Supply into the Bay

The continued health of Florida Bay depends upon maintenance of brackish estuarine communities along its coastal margins and prevention of excessively high salinity conditions within the bay itself. Significant amounts of freshwater flow are required in order for desirable salinity concentrations to be sustained. The sources of this fresh water include runoff, direct rainfall, seepage and other means. Inflow into the bay from the major canals via Taylor Slough is a major source of fresh water during dry periods.

The current analysis is designed to support the development of minimum flow criteria needed to protect existing resources for the Florida Bay area. These criteria will become increasingly important to the bay with the passage of time, as freshwater resources in the region become further divided among other uses. Setting a MFL criteria while freshwater sources are still available to the area will help ensure that amounts required to protect the Bay's resources from significant harm can be adequately quantified and secured.

Water Quality

Freshwater inflow to Florida Bay may provide an important source of nutrients that supports the primary productivity of this system. This bay, like other estuaries, depends on a certain minimum input of new nutrients to maintain productivity (Redfield 1958), but short-term limitation of new nutrients associated with period of low flow is unlikely to be harmful. Excess nutrients, however, may be a concern in terms of eutrophication and potential for hypoxic or anoxic conditions associated with organic loading and plankton blooms. Florida Bay is generally considered to be an oligotrophic estuary (Boyer et al. 1997). Nutrient inputs from the Everglades are likely important for the productivity of the bay, but the extent to which the quantity of this nutrient input is natural or augmented by human activity is uncertain. Phytoplankton blooms, which have been common in the bay since the early 1990s, may reflect impaired water quality and the influence of excess nutrients from the watershed (Brand 2002, Rudnick et al. 2005). If so, then periods with moderate and large quantity freshwater flow are of greater concern than periods when MFL alternatives may be in effect. Most of this nutrient input is in the form of dissolved organic matter (Rudnick et al. 1999)

Input of dissolved and particulate organic carbon to estuaries can come from terrestrial sources, as well as from primary or secondary production within the estuary. Terrestrial inputs of dissolved and particulate organic carbon to Florida Bay will be affected by minimum flow requirements. For the bay, organic matter inputs are largely in the form of dissolved compounds, which may affect productivity, dissolved oxygen demand, and nutrient availability. The relative importance of the input of external organic matter and associated nutrients versus internal production and cycling to the production of phytoplankton, benthic algae, and seagrass is uncertain.

A related factor to consider may be the impact of reduced flow on sediments and turbidity. With low freshwater flow and therefore low imported organic matter and nutrients during periods when MFLs may be in effect, the overall loading of organic materials into the bay would be low and the extent of hypoxic and anoxic conditions minimal. Alternately, reduced flow may promote the accumulation of organic matter (dissolved or particulate) in areas from which such material would otherwise be transported and dispersed farther into the bay during periods of rapid water movement.

Protection of Fish and Wildlife Habitat

Submerged aquatic vegetation (SAV), macroinvertebrates, birds, shellfish and finfish form prominent components of the Florida Bay ecosystem. SAV in the bay and the transition zone serve a variety of key functions. They provide habitat for numerous benthic and pelagic organisms such as invertebrates and fishes (Thayer et al. 1984). They increase benthic primary productivity and stabilize sediments (Stoner 1983, Virnstein et al. 1983, Gilmore 1987, Fonseca and Fisher 1986, Woodward-Clyde 1998). They provide food sources for trophically and commercially important organisms (Dawes et al. 1995, Virnstein and Cairns 1986) and can form the basis of detrital food chains (Zieman and Zieman 1989). Seagrasses cover much of the bottom of Florida Bay and provide the foundation for a substantial commercial and recreational fishery in the bay and neighboring waters, in part by supplying food and habitat for small fishes and invertebrates whose seasonal abundance is critical for successful growth and reproduction of the larger sport fish and commercial species, as well as for birds. Although less studied, SAV are also present in the ponds and creeks of the transition zone and provide similar benefits in terms of habitat, food sources, water quality, and substrate stabilization. Seagrasses and invertebrates are sensitive to changes in water quality (Kemp et al. 1983, Twilley et al. 1985) and are often included in monitoring programs as indicators of estuarine health (Tomasko et al. 1996). Restoration and protection of seagrass, macroinvertebrates, fishes and birds are major goals of the Comprehensive Everglades Restoration Plan.

Recreation

Recreational activities in Florida Bay include boating, fishing and birdwatching. MFL criteria are expected to sustain the aquatic communities that provide the landscape, fish and wildlife that support these recreational activities.

Watershed

The immediate watershed into Florida Bay consists of the natural communities of Everglades National Park and the islands of the Florida Keys. A crucial function fulfilled by the watershed and requiring consideration in the development of MFLs is the watershed's ability to supply appropriate quantity and quality of water at the right locations for fish and wildlife habitat in the bay and for other water resources and resource functions, such as recreational use and environmental enhancement/restoration of other ecosystems. The major competing needs are to manage surface water in adjacent areas for drainage, flood control and water supply.

Water Supply and Flood Control

The primary source of water flow from the regional water management system into Florida Bay is conveyance from the Water Conservation Areas southward through Taylor Slough and the C-111 Canal basin (mostly the southeastern panhandle of Everglades National Park). The amount of water delivered through these areas depends on regional rainfall and water level conditions and on the amount of water diverted to coastal canals to provide recharge to the surficial aquifer. The coastal canals in Miami-Dade County serve three primary functions: 1) to remove excess water from the canals' associated basins, primarily by discharging this water to tide, 2) to supply water needed for maintaining regional groundwater levels during periods of low rainfall and high water demand from agricultural and coastal wellfields and 3) to maintain groundwater table elevations at the coastal structures to prevent saltwater intrusion.

Wetlands

Wetland communities in the Florida Bay watershed offer storage, retention and infiltration sites for surface water flows. Groundwater and surface water are both used in areas adjacent to this watershed to meet potable water supply needs and for irrigation demands for landscape and agricultural crops. As urban and agricultural development continues, the volume, duration and frequency of floodwater flows into Florida Bay may increase. The existing infrastructure of drainage systems was never intended to eliminate flooding altogether in developed areas. Nearby natural and undeveloped regions can serve as locales for storage of excess floodwaters and infiltration of runoff and can function as vehicles for moving floodwaters away from developed areas.

Water Quality

Most of the immediate watershed into Florida Bay is undeveloped and serves as an important source of clean fresh water to the estuary by providing soil stabilization, low pollution loading, reduction of pollutants from runoff, a buffer from urban land uses and maintenance of the oligohaline zone. Urban and agricultural lands farther north and east can be sources of excess nutrients, pollutants and contaminants that may adversely affect downstream resources, especially during periods of high flow.

Protection of Fish and Wildlife Habitat

Maintenance of sufficient water depth within the watershed is needed in order to protect plant and animal communities in wetlands, sloughs and marshes. Freshwater wetlands in the watershed provide habitat for wildlife species important to predatory animals such as wading birds that feed upon those species and important also to recreational fishing and hunting interests. Freshwater fish species found in the Florida Bay watershed's wetlands, sloughs and marshes include largemouth bass, speckled perch, bluegill, shellcracker, redbreast, warmouth sunfish, bowfin, channel catfish, minnows and several exotics, and local game wildlife varieties found there include deer, hogs and ducks. In addition, the freshwater swamp community contains a number of species of trees and shrubs that provide important specialized habitats and food (such as fruits and seeds) to birds—most notably, to migratory and endangered bird species—and other wildlife.

The Florida Fish and Wildlife Conservation Commission's report, "Closing the Gaps in Florida's Wildlife Habitat Conservation System," (Cox et al. 1994) identifies the region as an important area in terms of maintaining several wide-ranging species that make up an important component of wildlife diversity in the state. Furthermore, the southeastern Florida region is a unique place for the concentration of migratory species. Many birds use the area for wintering, breeding, feeding and nesting. In addition, several species of marine fish depend on the estuary as spawning and nursery areas because of its relatively fresher water.

The fresh water from the watershed flows into protected lands and water bodies, including Everglades National Park, Biscayne National Park and the Florida Keys National Marine Sanctuary. These national preserves harbor several protected species (such as the American crocodile and the West Indian manatee, subspecies Florida manatee) that rely on appropriate timing and distribution of freshwater inputs to preserve their habitats.

Recreation

Recreational activities in the bay and its watershed include boating, birding, diving and fishing. These are considered non-consumptive uses. Identifying the MFLs required in the watershed is necessary in order to provide for adequate access and enjoyable use of the resource. MFLs are also needed to ensure adequate availability of water for plant communities that constitute habitat and landscape, and for wildlife that support these recreational activities.

ALTERATIONS

Hydrologic Changes

During the past century, the hydrology of south Florida underwent a vast series of modifications stemming from agricultural and urban development and the expansion of commercial and recreational activities. The structure and biological resources of Florida Bay and its watershed have been irreversibly altered by changes made to provide drainage and flood protection for cities, homes and farms, to provide water for irrigation and to improve boat access for recreational and commercial use.

Dredging and filling of tidal and freshwater wetlands throughout the watershed have resulted in the alteration of areas critical for the production of fish and wildlife and have reduced the watershed's capacity to store excess fresh water that falls during the rainy season for subsequent slow release to the estuary during dry periods. Loss of shoreline habitat to dredging and filling of coastal waters and wetlands has been relatively limited throughout most of the bay but

nevertheless has resulted in a decline in the tidal marshes and swamps that function as a natural filter to remove sediments, nutrients and pollutants from the water column.

Exchange with the Atlantic Ocean along the eastern side of Florida Bay was hampered by the Florida East Coast Railroad (1912) and the superseding Overseas Highway (1938), resulting in longer retention times within the bay and higher salinities and poorer water quality during dry periods. Construction of the water management system's canals, structures and pump stations in the upstream watershed has altered the volume, timing and distribution of freshwater flows to the bay.

Hydrologic alterations were not only produced by local human activities, such as water management, but also by larger scale changes in sea level. Sea level in south Florida has risen at least 20 cm (7.9 inches) over the past 100 years (Wanless et al. 1994) and this change has certainly affected the salinity regime of Florida Bay and the Everglades watershed (Rudnick et al. 2005). In particular, salt water intrusion of the southern Everglades has expanded the inland boundary of the salinity transition zone and increased the magnitude of salinity in this wetland (Ross et al. 2000). These alterations have been driven by both sea level rise and depletion of freshwater inflow and ground water levels.

Water Quality and Biological Changes

Florida Bay historically experienced lower salinity conditions than those prevailing during the twentieth century. According to available evidence(Brewster-Wingard et al. 2003), more fresh water used to enter the system from the Everglades watershed and nutrient loads were likely low as a result of the pristine state of the terrain. Submerged aquatic vegetation, macroinvertebrates, fish, wildlife and birds were abundant.

Hydrologic changes during the past century have altered the quantity, quality, timing and distribution of waters entering the bay and ultimately the biological conditions in the bay itself. The estuary has experienced increased loading of nutrients and pollutants, contributing to diminished water clarity, periodic algal and phytoplankton blooms, occasional periods of widespread seagrass mortality, highly varying salinities and increased duration, frequency and extent of hypersalinity. The combination of physical, hydrologic and water quality changes has resulted in periodic large-scale loss or destruction of habitats, especially of seagrass beds and their associated communities. Plant and animal communities in this ecosystem have been affected during these periods of habitat alteration and destruction, with an attendant decline in diversity and abundance of wildlife resources.

SUMMARY AND CONCLUSIONS

The Florida Bay ecosystem has been stressed and altered in the past century by effects of human activities, including the construction and operation of the C&SF project, which have altered the timing, distribution and quantity of fresh water flowing through the Everglades toward Florida Bay. Combined with sea level rise, these changes have altered the salinity regime of the bay and consequently the ecological structure and function of the bay (Rudnick et al. 2005). The bay's resources and functions have been altered by hydrologic modifications. Despite long-term and recent changes of ecosystem structure and function, the bay remains a productive and, compared to most Florida estuaries, relatively pristine environment with healthy habitat and rich fish and wildlife resources that support recreational activities.

Protections associated with MFL implementation and improvements associated with CERP are expected to sustain and then rehabilitate (restore) the Florida Bay ecosystem and its resource

functions. Determination of the lower limit of flows beyond which significant harm would occur to this ecosystem should be linked to the maintenance of appropriate salinity levels for MFL criteria determination. Salinity is a major ecological variable that controls important aspects of estuarine community structures and food webs (Myers and Ewel 1990).